

WHAT IS CLAIMED IS:

1. In an optical projection system, a high intensity discharge lamp for producing uv or visible light and having an anode electrode and a cathode electrode, wherein an effective correlated color temperature is maintained between 6500 and 7000 degrees Kelvin of continuous non-flash operation thereby increasing the efficacy of the lamp radiation output comprising:
  - (a) a lamp bulb envelope tube of single crystal (SC) sapphire tubing,
  - (b) wherein the lamp bulb envelope is cylindrical in shape with an inner diameter  $d$  of between 1 mm and 25 mm and an outer diameter  $D$  of 4.8 mm or more; and
  - (c) a fill in said envelope which emits uv or visible light radiation when an arc is struck between the electrodes and whose fill density pressure is in excess of 10 mg/cm<sup>3</sup>.
2. The apparatus of claim 1 wherein said bulb includes tungsten electrodes.
3. The apparatus of claim 1 wherein the fill pressure exceeds 20 atmospheres.
4. The apparatus of claim 1 wherein the efficacy exceeds 60 lumens/watt.

5. A high intensity discharge lamp for an optical projection system, the lamp producing continuous uv or visible light, wherein loss of bulb transparency vs. time is substantially reduced, thereby increasing the useful life of the bulb, the lamp comprising:

- (a) a lamp bulb envelope tube of single crystal (SC) sapphire tubing;
- (b) the lamp bulb envelope tube being cylindrical in shape, with an inner diameter,  $d$ , of between 1 mm and 25 mm and an outer diameter,  $D$ , of 4.8 mm or more,
- (c) a fill in said envelope which emits continuous uv or optical radiation under electrical arc discharge;
- (d) a plurality of electrodes within said envelope forming an arc gap therebetween; and
- (e) means to seal the envelope.

6. A high intensity discharge lamp for producing continuous non-flash uv or visible light wherein color stability is maintained, thereby increasing the useful life of the bulb, comprising:

- (a) a lamp bulb envelope having opposite ends and consisting of a single crystal (SC) sapphire tube;
- (b) the lamp bulb envelope being cylindrical in shape, with an inner diameter,  $d$ , of between 1 mm and 25 mm and an outer diameter,  $D$ , of 4.8 mm or more;

- (c) a fill in said envelope which emits uv or optical radiation under electrical arc discharge; and
- (d) an anode electrode at one end of the envelope and a cathode electrode at the opposite end and plugs sealing each electrode to the envelope.

7. An HID lamp for producing continuous non-flash uv or visible light wherein arc stability is maintained, thereby increasing the usefulness of the bulb for projection applications comprising:

- (a) a lamp bulb envelope of single crystal (SC)-sapphire tubing;
- (b) the lamp bulb envelope being cylindrical in shape, with an inner diameter,  $d$ , of between 1 mm and 25 mm and an outer diameter,  $D$ , of 4.8 mm or more;
- (c) spaced apart metallic or carbon electrodes disposed in the envelope and with a discharge path therebetween forming an arc length;
- (d) a current conductor connected to each electrode and which extend from the envelope; and
- (e) a fill in said envelope which emits uv or optical radiation under arc discharge.

8. The apparatus of claim 7 in which the arc length,  $s$ , is 2 mm or less and said inner diameter,  $d$ , is less than 3.8 mm and the fill density is greater than 30 mg/cm<sup>3</sup>.

9. An HID lamp for producing continuous visible light electrodes wherein spectral output is closely matched to the solar response curve, thereby increasing the usefulness of the lamp for applications in which color rendition is important, comprising:

- (a) a lamp bulb envelope made of single crystal (SC)-sapphire tubing;
- (b) the lamp bulb envelope being cylindrical in shape, with an inner diameter,  $d$ , of between 1 mm and 25 mm and an outer diameter,  $D$ , of 4.8 mm or more;
- (c) an anode electrode and a cathode electrode within the envelope and with a gap therebetween;
- (d) a fill in said envelope which emits uv or optical radiation under continuous non-flash arc discharge, the fill including at least one of hydrogen, chlorine, sodium, scandium, sulfur and selenium.

10. The apparatus of claim 9 in which efficacy exceeds 75 lumens watt.

11. An HID lamp for producing a continuous non-flash uv or visible light, wherein the surface temperatures of the inside of the bulb are adapted to be up to 1400 degrees Celsius, increasing the useful power density in the bulb thereby making the bulb more useful in applications which require high lumens/cm<sup>2</sup> applications comprising:

- (a) a lamp bulb envelope of single crystal (SC)-sapphire tubing;
- (b) the lamp bulb envelope being cylindrical in shape, with an inner diameter,  $d$ , of between 1 mm and 25 mm and an outer diameter,  $D$ , of 4.8 mm or more;
- (c) a fill in said envelope which emits uv or optical radiation under arc discharge;
- (d) a pair of electrodes within the envelope and with a gap of less than 2 mm therebetween; and
- (e) means to form an arc in the gap having a temperature of at least 1000 degrees Celsius.

12. An HID lamp as in claim 11 wherein the conduction heat flux to the inside of the bulb exceeds 150 watts/cm<sup>2</sup>, increasing the useful power density in the bulb and thereby making the bulb more useful in applications which require high lumens/cm<sup>2</sup> applications.

13. An HID lamp as in claim 11 wherein the envelope has opposite ends and an inside wall;

end plugs composed of polycrystalline alumina or of single crystal (SC) sapphire; and

sealing means of glass doped with titanium or tungsten, sealing the end plugs to the opposite ends of the envelope at the inside wall.

14. An HID lamp as in claim 13 and wherein the envelop inside wall has opposite grooves proximate its opposite ends;

two end sealing plates each composed of niobium or tantalum, each plate fitting into the groove on the inside wall of the envelope.